The Applied Research Laboratory Pennsylvania State University and the Office of Naval Research - A Strategic Partner Relationship

By Janet Jonson

ARL's Early Beginnings

As the Applied Research Laboratory (ARL) honors and celebrates the 60th anniversary of the Office of Naval Research (ONR) in this issue of *CHIPS*, we would be remiss not to mention the strategic partner relationship between these two organizations. Solving challenges for the U.S. Navy for more than six decades, ARL has been working hand-in-hand with ONR to address fleet issues.

Demonstrated innovation and practicality in technology-based research have facilitated the laboratory into becoming a leader in naval science and technology (S&T), with preeminence in undersea missions and related areas.

As a Department of Defense designated, Navy University Affiliated Research Center (UARC), ARL maintains a long-term strategic relationship with the Navy, while also providing additional support to the other services.

ARL provides world-class technology solutions for national security, economic competitiveness, scientific discovery, technology demonstration and transition to application. Equally important, ARL is preparing future naval research and development (R&D) scientists and engineers to lead our nation forward as we embark into a very challenging and dangerous 21st century.

Established in 1945 to further the work of Harvard University's World War II Underwater Sound Laboratory effort, ARL had an initial contingent of 100 employees. Today, there are more than 1,000 scientists, engineers, technicians, support staff and students. ARL has an additional 250 associate members throughout the various interdisciplinary colleges within the university from which it draws.

ARL's Premier Facilities

The lab today is primarily science and technology-based, with leadership extending into research areas that include: acoustics; guidance and control; thermal energy systems; hydrodynamics; hydroacoustics; propulsion; materials and manufacturing; navigation; communications and information; and education.

ARL has world-class facilities that enable its researchers to develop, test and demonstrate technology solutions for the challenges that face the Navy, other armed services and the Department of Energy.

These facilities, which support both ARL and sponsor-driven programs, are equipped with the latest in hardware and software, and are staffed by leading experts, skilled technicians, and both graduate and undergraduate students.

Seahorse-class Autonomous Underwater Vehicle (AUV) from the Applied Research Laboratory (ARL) at Penn State University slides free after being released from Sea Fighter´s (FSF 1) stern ramp during launch and recovery demonstrations. At 28 feet, six inches, and weighing 10,800 pounds, Seahorse is an untethered, unmanned, underwater robotic vehicle, capable of pre-programmed independent operations. The demonstration is sponsored by the Office of Naval Research. Photos courtesy of the Office of Naval Research and the ARL.

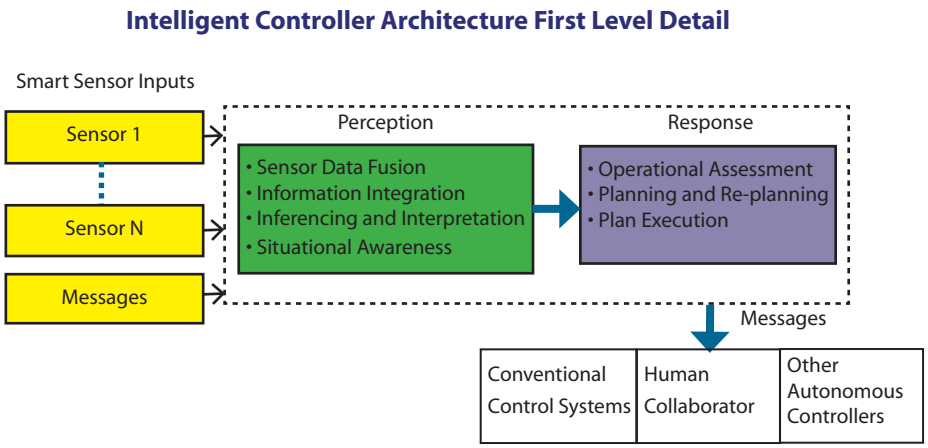

Figure 1.

Some of ARL's unique facilities and usage include: an acoustic test facility for determining the acoustic characteristics of sonar devices; an advanced nuclear test facility to test and evaluate economically a wide variety of fuel component designs; the Garfield Thomas Water Tunnel, a 48-inch diameter, closed loop water tunnel for ships; a high pressure test facility that simulates deep ocean environments; and a materials processing facility that provides state-of-the-art coatings capabilities; and a number of test vehicles that support technology development and demonstration in the undersea environment.

The Synthetic Environment Applications (SEA) Lab is a multi-use test bed facility providing various users access to advanced visualization, simulation and collaboration technologies. A navigation facility, located at Warminster, Pa., conducts research and tests precise navigation sensors and equipment.

ARL has collaborated with ONR over the past 60 years to develop S&T solutions that provide new innovations for our Navy and Marine warfighters and continues to do so. Most of the research has been in the area of underwater systems. Under ONR sponsorship, the following are some examples of the research with which ARL has been involved over the years.

Supporting Arms — ONR's Penn State Applied Research Laboratory Connection

ARL has developed designs and demonstrated propulsors for unmanned undersea vehicles (UUV), in particular, the thrust-vector pumpjet propulsor technology, which has been transitioned to Boeing's Long Term Mine Reconnaissance System (LMRS) UUV and Lockheed Martin's Advanced Development Unmanned Undersea Vehicle (ADUUV).

ARL is a world leader in understanding the physics of the flow of fluids over surfaces and in different environments using computational fluid dynamics (CFD) tools. Ongoing research continues in the development of Navy CFD tools. ARL has developed technology in liquid metal combustion such as that used in the Stored Chemical Energy Propulsion System engine, a closed-cycle thermal engine of the MK-50 torpedo.

ONR is sponsoring the technology of synthetic aperture sonar to be used in various vehicles. ARL has provided advanced technologies for guidance and control systems for underwater weapons. One example of the strong partnership between ARL and ONR is the development of the Torpedo Intelligent Controller. TIC is a software architecture aimed at enhancing the adaptability and performance of torpedo guidance systems.

TIC uses a behavior-based architecture, shown in Figure 1. Each behavior module is self-contained, operates independently, and takes control when needed to perform its specific function. The behaviors take action depending on the situation being encountered allowing the tactical planning to occur in real time i.e., during the course of an attack.

As future threats emerge and technology develops, the architecture provides for future growth in capability. This becomes particularly important as weapon acquisition programs move to an Advanced Processing Build (APB) model.

Functionality of the TIC tactical software could be extended to conduct the full mission of the future torpedo guidance systems that utilize broadband sonar bandwidths and enable a common tactical control architecture. The intelligent controller architecture is also being used in other Navy applications such as contact awareness for submarines and control of prototype large diameter UUVs.

ARL's future is no less predictable and no less challenging than at any other time in its history. Uncertainties, as well as opportunities, abound. As the Department of the Navy and ONR assess the future and its R&D priorities, ARL stands ready to provide a viable resource to the Navy to initiate those priorities.

The roots of ARL Penn State's success can be traced back to 60 years ago when it became aligned with the Office of Naval Research. The leadership and guidance provided by ONR was then, and continues to be now, invaluable. ONR's support has allowed ARL Penn State to grow and serve this great nation.

The future success of the ARL Penn State will depend on its ability to create and apply innovative technology solutions to the many challenges and opportunities of today and tomorrow.

Our motto remains — Discover, Develop, Deploy.

For more information about ARL Penn State please visit our Web site at http://www.arl.psu.edu/.

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